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ABSTRACT

This aim of this study was to analyze the content of students' verbal interactions within a problem-based learning context in biology. This was achieved through the qualitative analysis of the verbal protocols of three groups of two clases of ninth-grade female students (average/high ability, high/high ability, and average/average ability). The three groups were audio and video taped as they worked collaboratively in the problem-based learning environment to solve a problem case created by another group of students. Data were transcribed and analyzed using the idea unit approach. Overall, these groups were successful at negotiating roles and materials to be used to help them solve the problem case. Members in all three groups alternated in terms of researching and obtaining information, reading materials, and note-taking. Few disagreements were found, and when they did occur, they were often quickly resolved. When the students were of equal academic ability, the division of power was shared, but in the average/high ability group, the higher ability student tended to dominate the conversation and assume a more authoritative role. The implications of these findings, particularly of the inequality in participation among students of differing academic abilities, for instruction are discussed. (Contains 2 tables and 12 references.) (SLD)

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Investigating Student Interactions Within a Problem-Based Learning Environment in Biology

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Introduction and Theoretical Framework

A number of studies and reports within the last decade have called for changes in science instruction (American Association for the Advancement of Science, 1997; National Science Teachers Association, 1996). One of the many recommendations has been for science instruction to allow students greater opportunities to work in collaborative groups (Collins, 1997; Marx, Blumenfeld, Krajcik & Soloway, 1997). Problem-based learning incorporates many of the recommendations advocated by educational reform in that it permits students to actively and collaboratively participate in solving authentic problems (Barrows & Myers, in press). Problem-based learning, is based on a social constructivist perspective which emphasizes the importance of social interactions and negotiation in learning (Shepardson, 1996). As teachers increasingly implement problem-based learning in their classroom, it is essential that educators understand how group dynamics influence learning within these groups. In fact, even within the vast cooperative and collaborative learning literature a majority of studies have focused on the effectiveness of cooperative learning methods as compared to other instructional methods however, minimal attention has been paid to students' interactions within learning groups (Cohen, 1994; Nastasi & Clements, 1992). Deering & Meloth (1994) claimed that greater number of descriptive studies are needed to examine interactions within groups and how this impacts learning. Blumenfeld, Marx, Soloway & Krajcik (1996) claimed that although ideally all group members should participate equally and actively in groups there are often problems of unequal participation. Many researchers have suggested that differences in participation are attributed to status difference amongst the students (Petersen, Johnson & Johnson, 1991). Academic status characteristics are considered most powerful of all status characteristics in that, those who are seen as having more ability relative to the group dominate those who are seen as having less ability (Cohen, 1995).

Objective of the Study

The aim of this study was to analyze the content of students' verbal interactions within a problem-based learning context in biology. This was achieved through the qualitative analysis of verbal protocols of three groups of students (average/high ability, high/high ability, and average/average ability). Some of the questions addressed in the study included: (a) the manner in which students negotiated roles and materials used (b) the manner in which requests for explanations, information & clarifications were fulfilled by another member, (c) leadership within the group as characterized by the number of directives and non-directives, and (d) the manner in which conflicts were dealt with and resolved within the group.

Methodology

Participants

The sample consisted of 3 groups selected from two classes of grade nine biology students (N=52) attending a private all girls school in the Montreal area. The three groups included: one group consisting of two high ability students, a second group consisting of one average ability student and one high ability student and a third group with two average ability students. Students were classified as average or high ability by their teacher, based on their standing in the class. All students were from upper-middle class backgrounds and were approximately 14 years of age. Students from the two classes had the same teacher and followed the same curriculum. In addition, students had previous experience working in collaborative groups.

Materials and Procedures

The three groups were audio and video taped as they worked collaboratively in a problem-based learning environment to solve a problem case created by another group of students. All diseases in the problem cases had been chosen by the classroom teacher and were part of the circulatory or nervous systems, since these were the systems that students were learning about at the time of the study. Included in the problem case was a description of a fictitious patient's name, gender, medical history, and initial patient problems including vital signs and symptoms. In order to solve the patient case students had to work collaboratively to generate hypotheses, collect information and interpret their data as to whether or not the data presented positive or negative evidence to support or reject their diagnosis. In addition, to a diagnosis, students provided a written explanation of the disease, it's causes and possible treatments for the disease. Students were given one class period and the remainder of a week to solve the problem case and present it to the class. Data collection during the class period took place in the school's library. This location was chosen for two reasons: (a) the availability of resources students needed to help them solve their problem case, such as medical books, encyclopedias, two Macintosh computers with internet access as well as a teacher, two experimenters and a librarian who were on hand to help students obtain the information they needed, and (b) the library was an ideal setting for data collection.

Data Analysis

Data collected from video and audio recordings were transcribed and analyzed using the idea unit (Pontecorvo & Girardet, 1993). The idea unit refers to the smallest unit in which discourse is analyzed characterized by a single statement that in turn, corresponds to a linguistic clause. In addition, a product/process approach was used in analyzing the data. That is, all categories developed and used to analyze the data were developed posteriori and arose from the

context of the situation itself. The goal was to search for patterns versus imposing patterns on the data. All videotapes were reviewed three times in order to establish patterns. The first review revealed a pattern of social interactions and actions within the three groups. A second review was conducted to revise the emerging patterns. The final review established the specific categories in the table below.

Conversation Codes	Operational Definitions
Negotiation of Roles	An interaction sequence between members in a group whereby members discuss what steps to follow and how to divide the work load in order to achieve a certain goal
Negotiation of Materials	An interaction sequence between members in a group whereby members discuss what materials are needed to help them with solving their problem case
Requests for Explanations	A statement of request for explanation. For example, a step by step description on how to do a task.
Requests for Information	A statement of request for information.
Requests for Clarification	A statement of request for clarification.
Requests Fulfilled	Requests for explanation, information or clarification by one member is fulfilled by another.
Requests Not Fulfilled	Request for explanation, information or clarification by one member is not fulfilled by another member
Non-Directives	Comments or suggestions by one group member to another member
Directives	An order by one member towards another member
Task-related Conflict	Arguments pertaining to the assignment
Non-task Related Conflict	Arguments pertaining to something unrelated to the task
Resolution to a Conflict	Successful resolution to a disagreement
Appeal to Teacher	Appeal for teacher to intervene or help

Results and Conclusion

Verbal protocols of three groups of students were analyzed using the above coding scheme. Results showed that overall, groups where successful at negotiating roles and materials to be used to help them solve the problem case. Essentially, group members from all three groups alternated in terms of researching and obtaining information, reading through materials and note-taking. With regards to materials, group members discussed and negotiated about where to obtain useful information (e.g. encyclopedias, medical texts, CD-ROM etc.) and what medical terms to research. In terms of conflict, few disagreements emerged amongst the members of each group. When disagreements did occur, they were often quickly resolved amongst group members without any

appeals for help or interventions by the classroom teacher. The only significant difference between the three groups was in terms of sharing leadership within the group. In the two groups where students were of equal academic standing (high/high ability and average/average ability) the division of power was shared and no group member emerged as a true leader as evidenced by the number of non-directives used ("what about looking up S " or "we should look it up"). In the one group where students were of different academic standings (high/average ability), the higher ability student tended to dominate the conversation and assumed a more authoritative role. In addition, the high ability student tended to use more directives (e.g. "look it up" or "get B and L"). With regards to requesting and receiving help, the two groups of similar ability engaged in an equal amount of requesting and receiving help while in the mixed ability group the higher ability student tended to give more help often in the form of both answers and explanations. On the other hand, the average ability student had a higher incidence of requesting for information, explanations and clarification. Significant results are presented in the table below.

	Group #1		Group #2		Group #3	
	Average	High	High	High	Average	Average
Total # of Request	71.4%	28.6%	53.4%	46.6%	50.0%	50.0%
Requests Fulfilled	30.0%	70.0%	50.0%	50.0%	54.4%	45.5%
Directives	20.0%	80.0%	33.3%	66.7%	42.9%	57.1%
Non-directives	33.3%	66.7%	58.3%	41.7%	50.0%	50.0%

Overall, many interesting observations were noted when comparing the interactions between the three different groups (high/high, high/average and average/average). When students were of similar academic ability, students engaged in equal participation and the leadership and power within the group was shared. In the case of students with different academic ability, the student with the high academic ability emerged as the leader, often dominating the conversation and assuming a more assertive role. These results are consistent with findings by Cohen (1995) , who claimed that differences amongst group members can be explained in terms of status and that, high academic status by one member can result in the domination of that individual over another student of lesser academic status.

Educational Implications

Results from this small scaled study suggests that as collaborative learning methods such as problem-based learning are increasingly incorporated in the science classroom, teachers should: (a) be aware of status difference amongst students of different abilities when grouping students in mixed ability groups and (b) monitor interactions amongst students to ensure that all students cooperate equally in their groups. Regardless of a small sample size, this study proved beneficial in

providing a detailed description of what occurs between group members in terms of group dynamics. In addition, several interesting trends emerged from the present study that warrant further investigation through a larger scaled study addressing similar research questions.

References

American Association for the Advancement of Science. (1997). *Resources for scientific literacy: Curriculum materials*. Manuscript in preparation. (American Association for the Advancement of Science Project No. 2061).

Barrows, H.S. & Myers, A.C. (in press). Problem-based learning: A total approach to education. In H. Barrows & A. Kelson. (Eds.), *Problem-Based Learning*.

Blumenfeld, P.C., Marx, R. W., Soloway, E. & Krajcik, J. (1996). Learning with peers: From small group cooperation to collaborative communities. *Educational researcher, 25 (8)*, 37-40.

Cohen, E.G., & Lotan, R. A. (1995). Producing equal -status interaction in the heterogeneous classroom. *American Educational Research Journal, 32 (1)*, 99-120.

Cohen, E.G. (1994). Restructuring the classroom: conditions for productive small groups. *Review of Educational Research, 64(1)*, 1-35.

Collins, A. (1997). National science educational standards: Looking backward and forward. *The Elementary School Journal, 97 (4)* , 299-313.

Deering, P.D., & Meloth, M.S. (1994). A descriptive study of naturally occurring discussion in cooperative learning groups. *Journal of Classroom Interaction, 28* , 7-13.

Marx, R.W., Blumenfeld, P.C., Krajcik, J.S., & Soloway, E. (1996). Enacting project-based science. *The Elementary School Journal, 97 (4)*, 341-358.

Nastasi, B. & Clements, D. (1992). Social cognitive behaviors and high order thinking in educational computer environments. *Learning and Instruction, 2*, 215-238.

National Science Teachers Association. (1996). Pathways to science education standards. Arlington, VA: Author.

Petersen, R. P., Johnson, D.W. & Johnson, R.T. (1991). Effects of cooperative learning on perceived status of male and female pupils. *The Journal of social Psychology, 131(5)*, 717-735.

Shepardson, D. P. (1996). Social interactions and the mediation of science learning in two small groups of first-graders. *Journal of Research in Science Teaching, 33*, 159-178.